

There are currently a number of schemes which attempt to automatically distinguish an original Compact Disc from an unauthorized copy by storing a special pattern, such as a decryption key, on the Compact Disc in such a way that the special pattern is not readily copyable. For example, U.S. Pat. No. 5,400,319 to Fite et al. ("CD-ROM with Machine-Readable I.D. Code") discloses the use of a laser to selectively destroy portions of the reflective layer of the CD-ROM, thereby creating addressable defects in which a serial number may be encoded. U.S. Pat. No. 5,563,947 to Kikinis ("CD-PROM") discloses a similar use of a laser to physically damage selected sectors and thereby produce a pattern of unreadable sectors in which a decryption key may be stored. And U.S. Pat. No. 5,703,858 to Mitchell et al. ("System for Encoding a Glass Master to Enable Detection of a Counterfeit Optical CD-ROM") discloses the use of a high-frequency random modulation of a laser to produce random defects in the CD-ROM at the master level by selective destruction of predetermined sectors. All of these techniques, as well as other currently-available commercial techniques for copy-protecting a Compact Disc, involve creating damaged or otherwise unreadable portions of the Compact Disc. The theory behind such techniques is that ordinary consumer Compact Disc recording equipment is not intended to produce defects in the recorded copies made therewith, and therefore an unauthorized copy produced on such equipment should lack the unreadable areas in which the decryption key or other pattern is encoded. If this were in fact reliably the case, then such techniques would provide means for authenticating an undetermined Compact Disc. The present inventor, however, has found that it is possible to reproduce unreadable sectors in a copy by using ordinary consumer Compact Disc recording equipment with the appropriate software. Thus, a person with access to such appropriate software would be able to easily defeat such schemes relying on unreadable sectors and thereby create an unauthorized copy of a Compact Disc which will be incorrectly discerned by these authenticating schemes to be an original Compact Disc. In effect, all the schemes currently known in the art for providing copy protection of Compact Disc by encoding patterns in damaged or unreadable data areas are of limited value in distinguishing an original Compact Disc from an unauthorized copy and offer only limited protection against making unauthorized copies.

International Publication No. WO 98/08180 of PCT/IL97/00266 by the present inventor et al., which is incorporated by reference for all purposes as if fully set forth herein, discloses a method for authenticating digital optical media by recording and reading two classes of invalid symbols on the digital optical media. One class of invalid symbol is referred to as an "ambiguous symbol". An ambiguous symbol is a non-standard symbol, and is characterized by having two distinct data values instead of a single data value (an ambiguous symbol may therefore also be referred to as a "bistable symbol", and these two terms are herein interchangeable). Having a single data value is a characteristic of a standard symbol. When reading an ambiguous symbol, however, the physics of the reading process is such that one of the two distinct data values is read randomly. An ambiguous symbol may be detected by reading a given symbol a number of times and comparing the results. If the same data value always is returned, the given symbol is a standard symbol. In contrast, if different data values are returned, then the given symbol is an ambiguous symbol. Hence, an ambiguous symbol encodes invalid data herein termed "ambiguous data". Writing ambiguous symbols requires special hardware, and therefore ambiguous symbols

are not reproducible by ordinary digital optical media recording equipment. Consequently, the presence or absence of these ambiguous symbols serves to confirm or deny, respectively, the authenticity of a specific instance of digital optical media: provided that the original digital optical media were produced with these ambiguous symbols, then a specific instance of the digital optical media having the ambiguous symbols may be determined to be authentic, whereas a specific instance of the digital optical media lacking the ambiguous symbols may be determined to be an unauthorized copy. In order to make a determination of the authenticity of a specific instance of digital optical media, it must be possible to detect the presence of the ambiguous symbols using an ordinary player of the digital optical media. Ambiguous symbols, however, are considered according to the standards to be errors, and the player's error-correcting mechanism attempts to correct the ambiguous symbols to have a single value. If the player is successful in correcting ambiguous symbols, then ambiguous symbols will not be detectable using that player. Therefore, International Publication No. WO 98/08180 of PCT/IL97/00266 also discloses a method of overriding the error-correction of a player by recording a second class of invalid symbols on the original digital optical media in such a way as to disable the error-correcting mechanism for the ambiguous symbols. (A symbol belonging to this second class of invalid symbols is herein referred to as an "undefined symbol", and is characterized by not having a data value assignment in the standards. There are a total of nine such undefined symbols for Compact Disc, and they are immediately detected as invalid symbols by a Compact Disc player, as opposed to invalid symbols which are defined in the standards, but which have incorrect data values and which require processing by the player's error-detection mechanism and/or error-correcting mechanism in order for the player to detect them as invalid symbols.) Unfortunately, however, the published standards for digital optical media contain specifications for only the digital optical media and do not contain any specifications for players of the digital optical media. Consequently, there are no universal standards for players of digital optical media. As a result, the capabilities of the players vary considerably from one player to another, and therefore the method disclosed in International Publication No. WO 98/08180 of PCT/IL97/00266 may not work with all players of digital optical media. With certain players, it may not be possible to detect ambiguous symbols because of the specific error-correcting mechanisms of those players.

Therefore, it would be highly advantageous to have a method and system for authenticating an undetermined digital optical media which cannot be defeated utilizing commercially-available copying equipment, regardless of the software employed, and which will be usable with all players of the digital optical media. This goal is met by the present invention for use with Compact Disc digital optical media.

#### SUMMARY OF THE INVENTION

The present inventor has realized that the difficulty in detecting ambiguous symbols recorded on digital optical media using certain players is a result of differences in the error-correcting mechanisms employed by those players. Although the mathematical algorithms of the error-correcting mechanisms are specified in the standards for digital optical media, there are many different ways of implementing the algorithms, and this means that a way of overriding error correction that works for one player may not work for another player. To overcome this problem so